श्री चित्रा तिरुनाल आयुर्विज्ञान और प्रौद्योगिकीसंस्थान, तिरुवनंतपुरम्-11

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY

THIRUVANANTHAPURAM—695 011

ENTRANCE EXAMINATION - ACADEMIC SESSION JANUARY 2022

Program: PhD Physical Sciences

Time:90 Minutes

Max. Marks: 100

(Select the most appropriate answer)

(There are **no negative** marks for wrong answers)

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1 The degrees of freedom of a rigid body moving freely in three dimension is

a. 3
b. 6
c. 1
d. 2

2 Under which condition, P=aq+p ; Q=bq+p (a,b are constants) will be a canonical transformation

a. a=b
b. ab=1
c. b=1+a
d. a=1+b

3 A simple harmonic oscillator with angular frequency w in one dimensional space has a eigen state which is odd under parity operation and vanishes 3 times in the interval 0<x<infinity. The energy eigen value of that state in units of Plancks constant is

a. 7.5 w/(2π)
b. 6.5 w/(2π)
c. 3.5 w/(2π)
d. 4.5 w/(2π)

4 If the expectation value of the momentum operator in a state ψ(x) is <p> then the expectation value of the momentum operator in the state φ(x)=ψ(x)exp(ix) is

a. 0
b. <p>
c. <p> - h/(2π)
d. <p> + h/(2π)

5 Which causes fine structure splitting in hydogen atom

a. Spin-orbit coupling of electron
b. Spin -orbit coupling of proton
c. J-J coupling between electron and proton
d. spin-Spin coupling between electron and proton

6 Consider two non-interacting one dimensional simple harmonic oscillators with same angular frequency (w). If the total energy of the system is 12hw/(2π) the number of possible microstates is

a. 11
b. 12
c. 13
d. 1

7 The de Broglie wavelength of a neutron at 27 degree Centigrade is λ, what will be its wavelength at 927 degree Centigrade

a. $\lambda/2$
b. 2λ
c. 4λ
d. $\lambda/4$

8 Which colour is scattered the most

a. Red
b. Green
c. Blue
d. Yellow

9 If q1+q2=q, then force between q1 and q2 will maximum for what value of |q/q2|

a. 0.5
b. 1.5
c. 2
d. 0.75

10 The phase space diagram for a free particle in one dimension having energy E and moving between x=-L to x=+L will be a

a. Square
b. Circle
c. Rectangle
d. ellipse

11 The resistance of 20 cm long uniform wire is 5 ohm. The wire is stretched to a uniform wire of 40 cm length. The resistance now will be (in ohms)

a. 10
b. 20
c. 5
d. 2.5

12 7 Capacitors each of capacitance 2 mF are to be connected to obtain a capacitance 10/11 mF. Which of the following combinations will be connected in series

a. 5 in series, 2 in parallel
b. 4 in parallel, 3 in series
c. 3 in parallel, 4 in series
d. 5 in parallel , 2 in series

13 The work done to blow a bubble of volume V is W. The work done in blowing a bubble of volume 8V

a. W
b. 2W
c. 4W
d. 8W

14 100 X0 .011 in binary system is equal to the number in decimal system

a. 1.1
b. 1.5
c. 0.11
d. 0.15

15 In the context of Logic Gates, let $X=AB\bar{C}+B\bar{C}A+C\bar{A}\bar{B}$, Values of X for (i) A=B=C=0 and (ii) A=B=C=1

a. 1 and 1
b. 0 and 1
c. 1 and 0
d. 0 and 0

16 X-rays are

a. Charge less
b. negatively charged particles
c. positively charged particles
d. visible to human eye

17 In photo-electric effect, the maximum kinetic energy of the electron emitted from the surface depends on

a. work function of the surface
b. frequency of the incoming photon
c. intensity of the incoming photons
d. work function of the surface and frequency of the incoming photon

18 Escape velocity to overcome Earth's gravity is 11km/s. What is the escape velocity of a star whose mass and radius are 40000 and 100 times that of Earth?

a. 4400 km/s
b. 220 km/s
c. 2420 km/s
d. 440 km/s

19 What is the difference between the mass of the nucleus and the sum of the masses of its individual nucleons

a. Binding Energy
b. Binding energy per nucleon
c. Mass defect
d. None of the above

20 Incident beam is reflected off by a plane mirror. Incident beam being the same, if the plane mirror is rotated by k°, the reflected beam will rotate by

a. k°
b. 0.5k°
c. 2k°
d. 4k°

21 Which of the statements is FALSE?

a. Fundamental interactions are irreducible forces that act between the elementary particles composing all matter.
b. There are four fundamental interactions: gravitational, electromagnetic, weak nuclear, and strong nuclear.
c. Gravitational interaction has infinite range
d. Electromagnetic interaction has finite range

22 All matter has wave-like nature, the de Broglie's wave–particle duality is represented by

a. $\lambda = h/p$
b. $\lambda = 2h/p$
c. $\lambda = hp$
d. $\lambda = p/h$

23 Which of the statement do NOT correspond to the second law of Thermodynamics?

a. All natural processes tend to proceed in a direction which leads to a state that has more random distribution of matter and energy.
b. Energy can neither be created nor destroyed; it can just be converted from one form to another.
c. Every system wants to achieve a state of maximum disorder or randomness.
d. The total change in entropy of a system plus its surroundings will always increase for a spontaneous process.

24 Water enters a garden hose of diameter 2 cm with a velocity of 2 m/s. Calculate the exit velocity of water from the garden hose when a nozzle of diameter 0.5 cm is attached to the end of the hose.

a. 16 m/s
b. 32 m/s
c. 64 m/s
d. 8m/s

25 An animal has a body temperature of 27°C. What is the peak wavelength of its body emission? Take the Wien's displacement constant = 0.003 Km.

a. 15 um
b. 15 um
c. 10 um
d. 111 um

26 Which of the following statements are TRUE:
1. The first Nobel Prize in Physics was awarded to Wilhelm Röntgen for the discovery of X-rays.
2. Nobel prize for the year of 2020 was given for the discovery of a super massive compact object at the centre of our galaxy.
3. C.V. Raman got the Nobel Prize in the year of 1930 for his work on the scattering of light and for the discovery of the Raman effect.

a. Only 1
b. Only 1 and 3
c. Only 1 and 2
d. 1, 2, and 3

27 Which of the following is TRUE?

a. The straw appears bent as it enters liquid because of diffraction of light
b. It takes around 8 seconds for light to travel from the Sun to the Earth
c. The colors of the sunset result from absorption of the light
d. Twinkling of a star is due to atmospheric refraction of the starlight

28 A simple pendulum has a period of 2s in planet Alpha. The same pendulum has a period of 3s in planet Beta. What the ratio of the gravity of planet Alpha to the gravity of planet Beta?

a. 2/3
b. 9/4
c. 4/9
d. 3/2

29 Which of the statements is FALSE?

a. Sound waves travel faster through a metal than in water
b. Sound waves travel faster in water than in air
c. Sound waves travel faster in air than through a metal
d. Sound waves cannot travel in vacuum

30 In laboratory, a student is performing an optics experiment. A thin bi-convex lens of diameter 5cm is positioned at distance 400mm from a point source (emitting monochromatic light at 633nm). The incoming beam from the point source at the lens covers the full diameter of the lens. The exiting beam from the lens has the same dimension of 5cm diameter at any two distances in the direction of the beam. What is the focal length of the lens (at the wavelength of 633nm)?

a. 400 mm
b. 80 mm
c. 200 mm
d. 800 mm

31 Which is the odd one out?

a. X-ray imaging - Absorption
b. Ultrasound imaging - Reflection and Transmission
c. MRI - Magnetic Resonance
d. CT - Reflection

32 The X-ray crystallography mainly uses which among the following properties of electromagnetic radiation?

a. Reflection
b. Diffraction
c. Interference
d. Refraction

33 In nuclear reactor, in order to slow down the fast neutrons the target material should contain

a. Heavy Nuclei
b. Light Nuclei
c. Intermediate Nuclei
d. Radioactive Nuclei

34 Lorentz transformations assume

a. Space and time are both relative
b. Space is relative but time is absolute
c. Space is absolute but time is relative
d. Space and time are both absolute

35 According to Schrodinger, a particle is equivalent to a

a. Single Wave
b. Wave packet
c. Light wave
d. Cannot behave as wave

36 The photo diode as compared to a photo transistor has

a. Faster switching time
b. Lower sensitivity
c. Higher size for the same value of output current
d. Slower switching time

37 The change in entropy is

a. Positive in a reversible change
b. Negative in an irreversible change
c. Positive in an irreversible change
d. Negative in a reversible change

38 Which of the following effects occurs for transverse waves but not for longitudinal waves?

a. interference
b. diffraction
c. reflection
d. polarization

39 For a parallel plate capacitor with plate area" A" and plate separation "d" the capacitance is proportional to which of the following?

a. A divided by d squared
b. A times d
c. A divided by d
d. d divided by A

40 A first order phase transition is accompanied by

a. A change in free energy
b. A change in chemical potential
c. A change in enthalpy
d. No change in enthalpy

41 The average translational kinetic energy of the molecule of a gas will be doubled if

a. At constant volume its pressure is doubled
b. At constant volume, its pressure is halved
c. At constant temperature, its pressure is doubled
d. At constant temperature, its pressure is halved

42 Regarding diffraction which of the following is false?

a. it is best explained with the wave theory of light
b. it occurs when there is an obstruction to the light
c. both constructive and destructive interference occurs
d. it decreases with longer wavelength

43 To obtain laser from a system, the stimulating radiation must be

a. An electromagnetic wave of any frequency with suitable phase
b. An electromagnetic wave of any frequency with any phase
c. An electromagnetic wave of suitable frequency with any phase
d. Any wave with suitable frequency

44 The device which converts heat into mechanical work is

a. Motor
b. Generator
c. Heat Engine
d. Energy Converter

45 According to wave mechanics, a free particle can possess

a. Discrete energies
b. Continuous energies
c. Only one single value of energy
d. None of these

46 When a wave enters from one medium to another medium, which characteristics change?

a. Frequency and velocity
b. Frequency and wavelength
c. Wavelength and velocity
d. Frequency, wavelength and Velocity

47 Mobility of the electron is

a. flow of electron per unit electric field
b. reciprocal of conductivity
c. average electron drift velocity per unit electric field
d. none of these

48 Magnetic materials which can be readily magnetized in either direction are called

a. soft magnetic materials
b. hard magnetic materials
c. low hysteresis loss materials
d. high hysteresis loss materials

49 Electrons behave as waves because they can be

a. deflected by an electric field
b. diffracted by a crystal
c. deflected by a magnetic field
d. used for ionize a gas

50 Magnetic susceptibility χ is

a. dipole moment per unit volume
b. torque per unit area
c. magnetization per unit magnetic field intensity
d. none of these

51 The temperature at which a conductor becomes a superconductor is called

a. Superconducting temperature
b. Curie temperature
c. Onne's temperature
d. Transition temperature

52 For a given dielectric, the electronic polarizability

a. increases with temperature
b. decreases with temperature
c. is not affected by temperature change
d. may increase or decrease with temperature

53 According to Moseley's law, the frequency of the characteristic X-radiation is proportional to the square of

a. atomic weight of the element
b. atomic number of the element
c. ionization potential of the element
d. none of these

54 In a dielectric, the polarization is related to the applied field as a

a. linear function
b. square function
c. exponential function
d. logarithmic function

55 The losses in a dielectric subjected to alternating electric field are determined by

a. real part of the complex dielectric constant
b. imaginary part of the complex dielectric constant
c. both real and imaginary parts of the complex dielectric
d. none of these

56 The temperature, below which certain materials are anti ferromagnetic and above which they are paramagnetic, is called

a. Curie temperature
b. Neel temperature
c. Transition temperature
d. Weiss temperature

57 When a free electron recombines with a hole, there results

a. release of energy
b. absorption of energy
c. no change of energy
d. emission of alpha particle

58 The factor responsible for spontaneous polarization is

a. free electrons
b. atoms
c. permanent dipoles
d. none of these

59 Each ferromagnetic material has a characteristic temperature above which its properties are vitally different from those below it. This temperature is called

a. demagnetization temperature
b. Curie temperature
c. Transition temperature
d. Faraday's temperature

60 Below the ferromagnetic Curie temperature, the ferromagnetic material exhibits B H curve in the form of

a. B-H loop
b. straight line
c. exponential curve
d. B-H curve without loop

61 Genome of COVID-19 causing virus genome is made of

a. ssDNA
b. dsDNA
c. ssRNA
d. dsRNA

62 PPE means?

a. Public private enterprise
b. Personal protective equipment
c. Public protection entity
d. Personal protection enterprise

63 In a certain code "DIVISION" is written as "DVISOIN", then how is "STATES" written?

a. SATETS
b. SATTES
c. SAETTS
d. STTAES

64 A room has 10 doors. In how many ways one can enter through a door and exit through a different door?

a. 9
b. 10
c. 100
d. 90

65 In this "see and tell" sequence, what is the next number?: 1, 11, 21, 1211, 111221, _____.

a. 312211
b. 1112221
c. 1112222
d. 112131

66 At extreme depths in the sea (beyond 170 m depth), divers experience hallucinations, dizziness, tremors etc because of --------- .

a. hyperventilation
b. decompression sickness
c. high-pressure neurological syndrome
d. diving reflex

67 Which is the primary stress hormone

a) cortisol
b) aldosterone
c) adrenaline
d) noradrenaline

68 Name a plastic-degrading systems

a. PETase
b. ACE
c. MHETase
d. both 1 &3

69 SARS-CoV-2 spike protein is a

a. surface glycoprotein
b. small envelope protein
c. nucleocapsid protein
d. matrix protein

70 Covishield is a ---------- type of vaccine

a. whole virion inactivated
b. recombinant, replication-deficient adenovirus vector encoding Spike protein
c. mRNA
d. DNA

71 Paralympic Games 2020 was conducted at

a. Abu Dhabi
b. Tokyo
c. Rio
d. Beijing

72 Nobel Prize for Physics in 2020 was awarded for the discovery of

a. cosmology
b. optical tweezers
c. theory for Black hole formation
d. discovery in alloys

73 The theory of relativity is presented by which scientist

a. Albert Einstein
b. Isaac Newton
c. Stephen Hawking
d. Marie Curie

74 Total number of elements in the Periodic table

a. 112
b. 118
c. 115
d. 127

75 Which one is the purest form of carbon

a. coal
b. diamond
c. graphite
d. iron

76 The membrane proteins can span across the lipid bilayer strictly due to the presence of

a. alpha helices
b. parallel beta sheet
c. antiparallel beta sheet
d. zinc finger domain

77 To detect specific macromolecule or structure by electron microscopy, the frequently used procedure is to couple the antibody with

a. Osmium tetraoxide
b. Alexa 568
c. Gold Particle
d. Cy5

78 The inner cell mass of mammalian embryo in the blastocyst stage are

a. totipotent
b. pluripotent
c. multipotent
d. unipotent

79 Which of the following number is a prime number

a. 121
b. 163
c. 183
d. 1020

80 The enzyme Rennin is secreted in which among the following parts of the Alimentary Canal?

a. Mouth
b. Duodenum
c. Pancreas
d. Stomach

81 Both prokaryotic as well as eukaryotic cells have

a. Lysosomes
b. Mitochondria
c. Ribosomes
d. Golgi Bodies

82 Which one of the following is does not involve in maturation of red blood cells

a. pyridoxine
b. tocopherol
c. vitamin B12
d. folic acid

83 Migration of individual cells from the surface into the embryo's interior is termed as

a. ingression
b. involution
c. invagination
d. delamination

84 Which of the following hormone is detected by pregnancy kits?

a. Estrogen
b. Progesterone
c. Human Chorionic Gonadotropin
d. Lutinizing Hormone

85 Five persons A, B, C, D, and E are sitting in a row. C in the middle of the group and D is at an extreme end. There are at least two persons between B and E. Which of the following statements is incorrect?

a. E can be on extreme left
b. A is always a neighbour of B or D
c. A cannot be on extreme left
d. E can be on extreme right

86 Each pixel in a liquid crystal display (LCD) television is composed of 3 sub-pixels that can transmit red, green and blue colours because

a. White light is made of three primary colours viz red, green, blue
b. Liquid crystals can only filter these primary colours
c. The human retina contains only three types of colour-sensitive cells
d. These colours are the most pleasing to the human eye.

87 The Nobel prize in physiology or medicine 2020 was shared by Harvey J. Alter, Michael Houghton and Charles M. Rice for

a. The development of a method for genome editing
b. The discovery of Hepatitis C virus
c. The discoveries of how cells sense and adapt to oxygen availability
d. The discoveries of molecular mechanisms controlling the circadian rhythm

88 The first WHO recognized outbreak of Nipah virus was reported in

a. Malaysia
b. Bangladesh
c. Singapore
d. India

89 Who among the following is a climate campaigner?

a. Verghese Kurien
b. Malala Yousafzai
c. Greta Thunberg
d. Michelle Obama

90 The only active volcano of India is located at

a. Gujarat
b. Haryana
c. Maharashtra
d. Andaman & Nicobar Islands

91 EJOT, DHLP, CFIL, ?

a. BHLM
b. BDFH
c. DGKL
d. DEIJ

92 A man walks 30 meters towards south. Then turning to his right, he walks 30 meters. Then turning left, he walks 20 meters. Again, he turns to his left and walks 30 meters. How far is he from his initial position?

a. 110 meters
b. 80 meters
c. 60 meters
d. 50 meters

93 The ratio of the ages of a man and his wife is 4:3. After 4 years, this ratio will be 9:7. If at the time of marriage, the ratio was 5:3, then how many years ago were they married?

a. 15 years
b. 12 years
c. 10 years
d. 8 years

94 The first track and field athlete to win a gold medal for India at the Olympics

a. Abhinav Bindra
b. PV Sindhu
c. Neeraj Chopra
d. Nirav Modi

95 By the end of next month my grandmother _____ in the same house for more than 80 years

a. will have been living
b. will live
c. will have lived
d. will be living

96 Leaf of a plant appears green in daylight. If this plant were observed in red light, what colour would its leaf appear ?

a. green
b. black-brown
c. red
d. blue

97 Twenty one liters of milk in a tank is to be divided into three equal parts using only5, 8 and 12 liters capacity cans. The minimum number of transfers needed to achieve this is.....

a. 3
b. 4
c. 5
d. 7

98 How many times starting at 1:00 pm would the minute and hour hands of a clock make an angle of 40 Degree with each other in the next 360 minutes?

a. 6
b. 7
c. 11
d. 12

99 Which is not an essential amino acid

a. proline
b. methionine
c. valine
d. lysine

100 Which Indian city has the Drink-from-Tap facility for the first time in India?

a. Bangalore
b. Srinagar
c. Trivandrum
d. Puri

Academic Session – January 2022

PhD Physical Sciences- Answer Key

1	b
2	c
3	a
4	d
5	a
6	b
7	a
8	c
9	c
10	c
11	b
12	d
13	c
14	b
15	d
16	a
17	d

18	b
19	a
20	c
21	d
22	a
23	b
24	b
25	c
26	d
27	d
28	b
29	c
30	a
31	d
32	b

33	b
34	a
35	b
36	d
37	c
38	d
39	c
40	b
41	a
42	d
43	c
44	c
45	b
46	c
47	c
48	a
49	b

50	c
51	d
52	c
53	b
54	a
55	b
56	b
57	a
58	c
59	b
60	a
61	c
62	b
63	a
64	d
65	a
66	c

67	a
68	d
69	a
70	b
71	b
72	c
73	a
74	b
75	b
76	a
77	c
78	b
79	b
80	d
81	c
82	b
83	c

84	c
85	b
86	c
87	b
88	a
89	c
90	d
91	b
92	d
93	b
94	c
95	a
96	b
97	d
98	c
99	a
100	d